

ERADICATION OF SALT MARSH MOSQUITOES

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SAN FRANCISCO BAY is a large area almost entirely surrounded by salt marshes of which approximately 120 miles of water frontage is under mosquito control. This work has been carried on for some years and is divided into five working districts, and one in the course of organization. The districts are as follows:

- Contra Costa Mosquito Abatement District
(control work to commence in 1927)
- Napa County Mosquito Abatement District
(organized 1926, 90 square miles)
- Marin County Mosquito Abatement District
(organized 1916, 125 square miles)
- Three Cities Mosquito Abatement District
(organized 1915, 80 square miles)
- Pulgas Mosquito Abatement District (organized 1915, 84 square miles)
- Matadero Mosquito Abatement District (organized 1915, 64 square miles)

There is, then, under control the large area of 443 square miles, which consists of broken hill land and marshes.

The above districts operate under the Mosquito Abatement Act passed by the California Legislature in May, 1915. Previous to this, control work had been carried on in Marin County and San Mateo County over a period of years, dating back to 1905, when it was inaugurated under Professor H. J. Quayle of the University of California.

These earlier control efforts demonstrated the need of an adequate measure for the financing of abatement work.

Comprehensive control work in San Mateo, Burlingame and Hillsborough, financed by the three cities themselves, led to the actual drafting of the Mosquito Abatement Act in 1915.

To organize a district it requires a petition to the Board of County Supervisors signed by 10 per cent of the registered voters of the district, which may be any size up to a whole county. All municipalities coming within the limits of the district must have the proposed district accepted by their councils, after which the petition goes to the Board of County Supervisors who hold a hearing when the petition is considered and all persons interested may appear and be heard. If the Board of Supervisors decides to create the district, the board appoints a board of trustees to serve without pay. This board of trustees has complete charge of the abatement work and is usually carried out by their appointing a full-time superintendent who hires whatever help he may require to do the work. The county is then empowered to levy taxes for this abatement work, not to exceed \$.10 on \$100 assessed valuation.

In the bay region of San Francisco, the tax averages \$.08 on the \$100, and this has been found to be adequate to finance all the work required. This has been found to be true in all the mosquito abatement districts in California with the exception of a few sparsely inhabited

small districts where the tax limit is insufficient.

The above districts are spending around \$50,000 annually for control work, divided as follows:

Napa.....	\$12,000
Marin.....	13,000
Three Cities.....	9,500
Pulgas.....	10,000
Matadero.....	8,000
Total.....	\$52,500

A large portion of this money is being spent on permanent improvements such as levees, drainage systems, tide gates, plowing of cracked land, etc.

The above list does not include the 12 other mosquito abatement districts in California which have been organized for the purpose of malaria control. These malaria districts have been operating for some time and are apparently successful in reducing the malaria morbidity.

PROBLEMS ENCOUNTERED

The chief problem is the control of *Aedes dorsalis* and *Aedes squamiger*. These two species are migratory in habit and breed in salt or brackish water. This explains the necessity of the extensive control work necessary on the marsh lands of the districts in the San Francisco Bay region. These two species have a considerable range of flight and have been found 15 miles inland from any possible breeding ground.

OPEN MARSH LAND

Open marsh land or land which is open to tidal flow is the simplest problem encountered, necessitating only the opening up of basins or depressions to tidal flow by means of drainage ditches. These drainage ditches remain open a number of years, being constantly flushed out by each successive tide. These ditches are about 18 inches wide and from 1 to 2 feet in depth. The access of the tide to the sloughs and depressions prevents the water from standing long enough to permit the completion of the life cycle of the

mosquito. It also permits small fish to enter which devour the larvae. Thus great tracts of land have been controlled by the construction of these ditches, work which is usually done by hand.

RECLAIMED LAND

By far the most difficult problem encountered is reclaimed land, especially reclaimed areas which, through neglect, have gradually formed natural breeding grounds. These abandoned levees and old leaky tide gates form a barrier which prevents the regular ebb and flow of the tide, resulting in accumulation of extensive areas of stagnant water, a most favorable condition for the breeding and hatching of salt marsh species.

Contrasted to the above neglected marsh areas, are the reclaimed lands where the levees are maintained in good repair and the drainage canals and automatic tide gates (or pumping plants) are kept up to the highest point of efficiency. In these areas the control work consists, in the main, of drainage by the construction of a few ditches and the application of oil on the drainage canals to prevent the emergency of the early spring broods of *Aedes dorsalis* and *Aedes squamiger*.

It is customary in all the districts to work for the coöperation of the land owners in order to accomplish the desired results. This coöperation takes many different forms of divided responsibility, such as the installation by the district of tide gates which are furnished by the land owners; plowing of cracked land by the owner or plowing partly paid for by the district and partly by the owners; the furnishing of power by the owner for pumping plants installed by the district; and in fact any equitable arrangement that is found satisfactory for the local problem involved.

In some instances, due to non-resident ownership or lack of appreciation of the value to be derived from efficient reclamation, it has been necessary for the district to assume entire control. On these areas, among which may be included the

neglected areas above mentioned, the control work is accomplished in the cheapest manner possible and consists of temporary repair of broken levees, installation of tide gates, and oiling by the district. •

TIDE GATES

These gates for the control of drainage by permitting the water to flow out at low tide and automatically closing at high tide by preventing back flow, take two different forms; namely, wood and iron. The most efficient gate has been found to be a combination of corrugated iron culvert which is riveted to a cast iron flange on which is hung a cast iron gate suspended by two hinges. The first gate of this nature was built by the superintendent of the Three Cities Mosquito Abatement District in 1913. It was afterward patented by a commercial concern and is now being furnished in large quantities to drainage works of various kinds. The advantages of the above gate over the old wooden type are as follows:

1. The mud crabs will not burrow along the sides of the corrugated culvert.
2. The gate is ground to a tight joint with a flange, reducing leakage to a minimum.
3. The gate swings practically horizontal during flood water, allowing the maximum flow through the pipe.
4. The installation is economical, because these gates can be installed easily with a crew of men between tides, the installation of a gate costing around \$150.
5. There is an absence of warping, found in all wooden structures exposed to alternating wetness and dryness.
6. There is no rotting out as in the case of wooden gates.

CRACKED LAND

Following the reclamation of tidal land and drainage of the same, there is a shrinkage and sinking of the enclosed surface which produces extensive cracking in the surface of the land. These cracks are from 2 to 14 inches in width and oftentimes 3 or more feet in depth. The water which accumulates in these

cracks is very hard to drain out, and water stands in them offering an ideal condition for the breeding of mosquitoes. In fact, it is often the case that mosquitoes are breeding in cracks when there is no breeding in open waters. Even when pumping is resorted to the drainage from these cracks is very slow.

The oiling of such an area is an enormous job and a difficult undertaking, especially where grass grows over the cracks, when it is difficult for the oil to reach the surface of the water below.

It has been found that the most efficient way to prevent breeding in such waters is to plow the land and fill the cracks by dragging and discing. The cost of such work varies with the type of land; badly cracked land cut up by numerous sloughs will cost approximately \$25 per acre, other areas costing between \$12 and \$15 per acre. The above work is done with heavy disc plows drawn by caterpillar tractors. The 60 H.P. seems to be the most efficient size to do this.

One concrete instance of coöperation between land owners and a mosquito abatement district is cited. The St. Vincent's Orphanage in Marin County had approximately 700 acres of such cracked land. This land had been used only for spring dry stock pasture for years and was an extensive breeder of mosquitoes. Oiling operations were costly and difficult, one season's oiling costing \$1,800 on this area alone. A coöperative arrangement was agreed upon between the orphanage authorities and the trustees of the mosquito abatement district whereby the land was plowed, a levee and pumping plant repaired, at a total cost of \$6,000. The 1925 crop of oat and barley hay from this land was valued at \$13,000; a practical demonstration that reclamation and mosquito control go hand in hand. Oiling this area in 1925 cost \$50, for oil used in the drainage canals alone.

PUMPING

As mentioned above, there is a decided shrinking and settlement of the marsh

land after reclamation and drainage have been accomplished. When the settlement is extensive it has been found necessary to resort to pumping in order to remove the last water from the bottom of the sloughs and drainage canals. The type of pump varies with the head encountered. Usually some form of low-lift pump is desirable. The Marin County Mosquito Abatement District owns and operates a vertical pump run by a 20 H.P. motor, pumping 3,800 gallons per hour, installed at a total cost of \$2,000. This pump in 1926 saved the district \$1,000 in oiling cost.

OILING

Oiling as a mosquito control measure should only be considered a temporary relief and a last resort to be used only in instances where permanent remedial measures are impossible. The oil used in the San Francisco Bay region is a mixture of crude oil with equal parts of "stove distillate." This makes a satisfactory oil which can be spread with knapsack pumps or power sprayers, and has sufficient body to accomplish death to the larvae before it evaporates from the surface. Crude oil costs 5 cents a gallon, and "stove oil" 8 cents a gallon.

A number of different types of power

sprayers are used from which the spraying can be done directly from trucks at distances varying from 50 to 100 feet; some from pressure tanks, others from rotary oil pumps driven by gasoline engines, or by power taken from the truck motor. Approximately all the oiling of the fresh water areas which are tributary to marsh lands is done with knapsack pumps. These are entirely inadequate when 500 to 600 acres are to be gone over. One instance where power spray pumps are used is on the property of the California Fruit Cannery Association. This ranch consists of 2,000 acres and has 15 miles of drainage canals, every foot of which is covered with oil three or four times a year to prevent breeding.

CONCLUSIONS

The public is satisfied with the results of the efforts put forward by the mosquito abatement districts, as evidenced by the few complaints received at their offices. The cost is low, averaging 80 cents a year to the property owner of a 5-room house assessed at \$1,000. Mosquito abatement has been partly responsible for the rapid growth in population and heavy expansion in real estate values in these areas, whereas before the districts were organized they were at a standstill.

SANITARIANS STUDY COST OF MEDICAL CARE

AS THE result of a conference of some 60 physicians, economists and sanitarians in Washington, D. C., May 17, a committee has been organized to study the cost of medical care. Dr. Ray Lyman Wilbur, president of Stanford University and a recent president of the American Medical Association, presided at the first session where the extent, adequacy and cost of medical services in the United States were broadly presented by Dr. Louis I. Dublin, Dr. Haven Emerson of New York, and Dr. C. C. Pierce, U. S. Public Health Service, Fellows of the A.P.H.A., John A. Kingsbury of New York, a member of the A.P.H.A., and Dr. Leo Wolman of New York. The second

session, at which plans for systematic and continuing study of the economic factors affecting the organization of medicine were developed, met under the chairmanship of Dr. Lewellys F. Barker of Baltimore, Md. A formal report prepared by a temporary committee which has been at work on this matter for the past year was presented by Dr. Winford H. Smith of Baltimore, Md., and Prof. C.-E. A. Winslow of New Haven, Conn., formerly president of the A.P.H.A. The committee which has the matter in hand plans for an adequately financed 5-year study of the facts. The temporary address of the committee is 1724 I Street, N. W., Washington, D. C.